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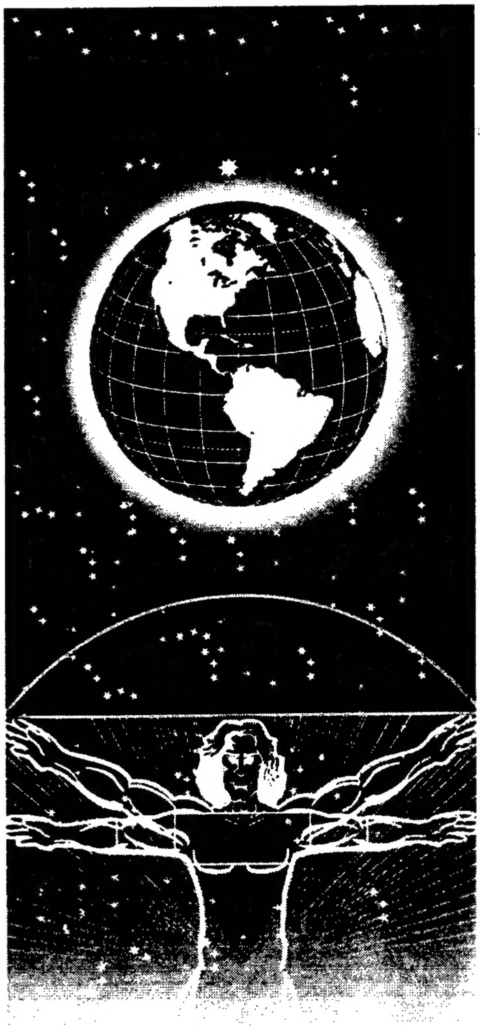

UNITED STATES AIR FORCE
RESEARCH LABORATORY

DEPLOYED FORCES INFORMATION AND EVALUATION SYSTEM (DEFINES) PHASE 1: OVERVIEW OF PERSONNEL LOCATING AND TRACKING TECHNOLOGY

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In the past, the Armed Services have encountered numerous difficulties in tracking personnel who changed component (i.e., Reserve to Active and back to Reserve); changed deployment status (i.e., deployed and re-deployed); or had become casualties. Further, the Services could not account for the physical whereabouts of its personnel. The campaigns of Desert Shield and Desert Storm exemplified the inadequacy of the Services personnel tracking mechanisms to account for its personnel who participated in these operations. The Services have also struggled to determine who was exposed to health hazards during deployments. The emergence and development of technologies such as the smart identification (ID) card, and new location determining systems like the Joint Personnel Asset Visibility (JPAV) system, and new location determining systems based on the Global Positioning System (GPS), could foster new and innovative ways to gather and use location data. The current project explored potential uses of emerging individual location tracking technology by the Air Force personnel community. The application opportunities discussed were to support military personnel research; to provide data on health hazard exposure assessments; and to respond to inquiries and address personnel management issues at the field command.

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Introduction

This report provides an overview of the current state of the art of technology to locate and track personnel for military applications. This effort is the initial phase of a planned larger project to develop a Deployed Forces Information and Evaluation System (DEFINES) for field command personnel management and post-deployment tracking. The first section provides a discussion of the GPS and the smart ID card technologies. The second section provides a summary of current and planned tracking capabilities within the Services. In particular, the Defense Integrated Military Human Resource System (DIMHRS) and JPAV are discussed. The Personal Status Monitor, Personal Information Carrier (PIC) and other technologies applicable to the medical community are discussed in the third section. The Land Warrior system and the digitized battlefield are discussed in section four. Finally, potential uses by the Air Force are given in section five.

In the past, the Armed Services have encountered numerous difficulties in tracking personnel who changed component (i.e., Reserve to Active and back to Reserve); changed deployment status (i.e., deployed and re-deployed), or had become casualties. Further, the Services could not account for the physical whereabouts of their personnel. The campaigns of Desert Shield and Desert Storm (DS/DS) exemplified the inadequacy of the Service personnel tracking mechanisms to account for personnel who participated in these operations. (SRA, 1995) The Services have also struggled to determine who was exposed to health hazards during deployments. Agent Orange concerns associated with Vietnam and Gulf War Syndrome problems from DS/DS are examples. The emergence and development of technologies such as the smart identification (ID) card, retrieval and display systems like the Joint Personnel Asset Visibility (JPAV) system, and new location determining technology based on the Global Positioning System (GPS), could foster new and innovative ways to gather and use location data, including support for personnel research; providing data on health hazard exposure assessments; and responding to inquiries and addressing personnel management issues at the field command.

Section 1: New Technologies and Their Commercial Application

Global Positioning System

DoD operates a satellite-based radio navigation system called GPS that provides location fixes in all parts of the world at all times. GPS is based on a space segment of 24 satellites in circular orbits about 10,900 nautical miles above the earth's surface. Each satellite orbits the earth twice a day in one of six planes, and continuously transmits two kinds of data in two different digital codes. The broadcast codes are Precision (P) and Coarse Acquisition codes (CA). Each satellite has unique P and CA codes. "The orbits of the satellites are spaced so that at least five of them are in theoretical view of any user at any point in time." (Dixon, 1995)

A master station at Colorado Springs acts as the control segment and a number of monitoring stations track the viewable satellites and act as conduits of information to the master station. The aim of the information transfer is to enable the satellite to transmit an accurately timed signal to a receiver. The time interval is turned into a distance measure and that data can be interpreted to represent a position line. The time interval is defined as the difference between the time that a receiver receives a P or CA code to its next reception. Receivers used by the military calculate time differences between P codes, while civilian receivers calculate time differences between CA codes. Signals can be sent to either military or civilian receivers.

The satellites are fitted with atomic clocks to record the precise time a signal is sent. The transmission times are computed by the receiver using a geometric equation leading to a location fix, which can be used for navigational purposes.

DoD controls access to these satellite signals. DoD can alter the signal band of these satellites so that only military receivers are able to receive the signals. Such actions may be followed during times of conflict, but are unlikely, since many Service units use civilian receivers.

DoD also controls the accuracy of satellites' signals. Military receivers have little variation in signals they receive, and are accurate to within 1 meter so military receivers are very accurate in providing navigational guidance. On the other hand, for security reasons, the CA signals only allow determination of horizontal accuracy to between 15 meters and 100 meters, and vertical accuracy (measuring altitude) to between 100 meters and 156 meters (Letham, 1996). The CA timing signals include random noise to reduce the precision of locations determined using them. Military receivers are able to use the more precise P codes because the values of the P codes are retained in memory for comparison to the arriving signals. The time differences between P codes can be measured more accurately than between CA codes. In a large part, the two-tier accuracy has been developed to allay fears of enemies using the GPS system against US interests.

The accuracy of GPS is also hampered by variations in the ionosphere and atmosphere. These factors slow the speed of the GPS signal. This produces an error in measuring distance since the timing of the signal is delayed. Hence, this distorts the accuracy of the position line by a few meters. To overcome these limitations as well as those due to random changes in the timing of signals, civilian receivers can be augmented with Differential GPS (DGPS). The accuracy of a DGPS is between 2

centimeters and 5 meters. (Letham, 1996) DGPS requires an additional, fixed position radio transmitter as a reference point. Data from the fixed transmitter is fed to a DGPS conversion box to which a civilian receiver is attached. Satellite signals received by the receiver are then adjusted using data sent by the radio transmitter to yield the improved accuracy.

Receivers can be large enough to mount on a solid platform or small enough to be hand held. The hand-held receivers are usually less than a pound, and are DGPS ready. Hand-held receivers are equipped with one of two types of antennas: Quadrifilar Helix or the Patch. The latter is omni-directional and therefore is better for receiving signals from overhead satellites. The Quadrifilar Helix is directional and is better receiving from satellites that are close to the horizon. Because the satellite signal cannot penetrate dense vegetation, rocks, buildings, or landforms, antennas have to be placed where there are no obstructions between them and the signals they receive. For instance, it would be better to mount the antenna on the roof of a car than in the interior.

Receivers provide altitude and location information on grids with coordinates using the World Geodetic System 1984. GPS can also translate its map coordinates to any other systems.

GPS systems are capable of storing multiple waypoints to define a route. The coordinates of the waypoints can be either the coordinates of the receivers' current location or the coordinates of any other specified location. Waypoints are listed and selected using a variety of methods to include: single waypoints with prompting by waypoint names; alphabetized list of waypoint names; and waypoints listed by proximity to present location. The choice of which method to use is affected by time constraints because data are entered one letter or number at a time.

Route functions are also incorporated into GPS receivers. These functions are used as guides to waypoints. Navigation statistics are usually given when using the route functions. These functions report bearing, distance, speed, desired track, course completed, cross-track, estimated time on route, and estimated time of arrival. Speed data can be displayed in metric, statute, or nautical miles per hour.

Commercial applications of the GPS range from using GPS collars to track migration patterns in wild life; aid navigation in outdoor activities, such as skiing, hiking and camping; automobile navigation systems; support search and rescue satellite-aided tracking[1]. GPS has increasingly become an important component of the production process of many industries.

GPS technology has also been used to track turtles in the open water. Turtles are fitted with Sony Walkman-sized transmitters that are placed on their backs. Each time the turtle surfaces for air, the transmitter sends data signals to an orbiting satellite. The satellite re-transmits the data to stations on earth, where it is retrieved by researchers. The data that is retrieved is in digital code that is deciphered using computer software. These codes allow the researchers to determine, with varying degrees of reliability, the latitude and longitude location of the turtle. Using computerized mapping programs, the researchers can also plot the location of the turtles and visualize the route taken and the speed of travel.

[1] The difference between tracking and navigation is that navigation is the process of getting from one point to the next. Tracking is the process of monitoring movement.

It usually is important to know current position and the waypoints during skiing, hiking or camping trips. GPS technology can aid in navigating between points during the trip. For example, on a skiing trip, GPS technology can aid in locating a campsite during a whiteout by allowing the skier to navigate on a straight course and alerting them when they are in the vicinity of their campsite.

General Motors has linked GPS with cellular telephone technology to develop its OnStar system. OnStar allows mobile subscribers to communicate with OnStar staffers housed in a central location 24 hours a day. The staffers can provide directions by car phone to the nearest gas station, GM dealer, hospitals, restaurants, banks, or to any other location.

More recently, GPS systems have been used in connection with external antennas to locate automobiles involved in accidents. In this system a microcomputer monitors the air-bag deployment system. If it detects that the airbag has deployed, the computer calls a service center over the car cellular phone giving information on the last known location as determined by the GPS system. The service center passes that information to the local emergency services.

Search and rescue systems use satellites to detect and locate emergency beacons carried by ships, aircraft or individuals. The search and rescue system consists of a network of satellites, ground stations, mission control centers, and rescue coordination centers. In the event that an emergency beacon is activated, the signal is received by a satellite and relayed to the nearest available ground station. The ground station, called a Local User Terminal, processes the signal and calculates the position of origin. The point of origin is transmitted to the mission control center where it is merged with identification data and other information on that beacon.

GPS technology is also employed by varied industries in their production process. For example, truckers use GPS technology to reach their destinations or to call for aid in times of need. Both UPS and Federal Express use GPS technology to track packages that are in transit between countries. Packages that are shipped internally in a country are tracked using a database system that uses location data from readers available to package handlers. Bar codes are printed on the packages to allow the readers to identify the package. Once the reader scans the data, the data are automatically fed into the database to support queries for location or status information.

Smart Cards

Smart Cards are credit-card like devices that contains a dime-sized silicon microprocessor that packs the computational power similar to that of the early 1980's Apple computer. (Christenson, 1997) It is capable of storing text, sound and images containing personal information. Most smart cards can store up to eight kilobytes of information. Improvements in technology would increase that ability to ten megabytes.

There are numerous commercial applications of Smart Card technology. For example, Ohio's welfare recipients use Smart Cards in place of food stamps, and the technology is considered to lessen the risk of welfare fraud. It is also widely used in France, where smart card technology is incorporated into all credit cards issued by the national bank.

Section 2: Use of the Technology by the Armed Services - Personnel Community

Clearly, there are many applications that can be transferred to military uses. This paper will focus on transfers to three communities within the military: the personnel community, the medical community, and the field commander. The term "personnel community" refers to personnel planning, management and research organizations above the operating unit level. The term "medical community" refers to deployed medical units, medical evacuation units, medical treatment facilities that receive casualties, and medical research units that support deployments either real-time or in after-action follow-up. The term "field commander" refers to commanders responsible for managing deployed forces. The following sections provide examples of how location generating and storing technologies and the resulting location data are being used or are planned for use by these three communities.

Defense Integrated Military Human Resource System

The Defense Integrated Military Human Resource System (DIMHERS), formerly known as Military Personnel Management for the Twenty-First Century (MPM-21), is DoD's response to problems related to tracking personnel movements. The Services have refined and developed their own data retrieval and display systems to track personnel location. For example, the Army created The Inter-Component Data Transfer (ICDT) for the purposes of exchanging data between the Standard Installation/Division Personnel System (SIDPERS-3) and the Reserve Component Automation System (RCAS) via the Total Army Personnel Data Base (TAPDB). This enables Army personnel managers to monitor status changes.

Recent experiences with Joint Task Force (JTF) operations, such as Operation Desert Storm, have underscored the importance of maintaining a detailed historical record of troop movements and locations within the Joint Operations Area (JOA). The potential use and presence on the battlefield of chemical and biological agents, whose full effects may become apparent only over a long period of time, makes this type of historical data an indispensable diagnostic, forensic and epidemiological resource.

Further, the JTF Commander-in-Chief (CINC) can use a database that contains near real-time data on personnel assets deployed in support of a contingency to see who is in the pipeline to theater, to compare the current estimates of the force with what is planned in the Time Phased Force Deployment List (TPFDL), and also to see the attributes (specialty, skill, demographic data, etc.) of the force. The JTF-CINC will also be able to adapt quickly to personnel bottlenecks by identifying comparably skilled personnel deployed across services.

There are many uses for tracking information. For example, such data can assist the Office of the Secretary of Defense (OSD), the Joint Staff, and the Services in accomplishing their personnel management objectives, in meeting real time operational needs. The data can also be used to support personnel research, to aid in exposure assessments, and to respond to inquiries and address personnel management issues. Moreover, such data would help the government fulfill its obligations to Service members

and veterans. For example, tracking intelligence will provide information to help identify individuals who may have been exposed to potential health hazards while serving on active duty. (SRA 1995) The implementation of a mandatory and uniform tracking requirement for DoD would ensure the availability and uniformity of this type of vital information to the JTF. (DoD doc# D0046-A005-FRD-U-002)

Presently, there is no standardized tracking capability among the Services. Each Service component commander maintains personnel asset visibility using Service-specific systems. The data dictionaries of these systems have not been fully standardized or integrated with their counterparts in other services, (DoD doc#D0046-A005-FRD-U-002). One source of variation in the tracking capabilities stems from differences in recording physical location of Service members. For example, the Air Force and Marine Corps record the physical location for each service member. The Navy and Army record the physical location of units, but not individuals.

DIMHRS also addresses skill data on deployed personnel. These data support management of the force. Another source of variation among the Services is the degree to which language and other skills are measured and tracked. For example, the Navy's and, to some extent, the Marine Corps' language data are based on self-evaluation rather than a formal language skill test. The Army and Air Force, on the other hand, collect data that is based on formal language skill tests. Clearly, a standardized method of collecting data on personnel language skills would aid the Commander of a JTF in managing the force efficiently. Finally, the extent to which civilians are tracked differs among the components of the Service. In many instances, the JTF Manpower and Personnel (J-1) staff must go back to each Service component for the required data and then manually aggregate it to respond to requests for JTF-wide information, (DoD doc#D0046-A005-FRD-U-002).

Changes to the Services' existing tracking technology have been proposed that would enable the Services to standardize the tracking data. The push to improve and standardize location data is under DIMHRS. A discussion of the capabilities and plans of each Service follows.

Navy: Source Data System (SDS) and Diary Management System (DMRS) collect and maintain information about Navy personnel in the regular component at the field level. SDS supports Continental United States (CONUS) sites, most ships, and selected overseas reporting. DMRS primarily supports overseas and shipboard reporting[2]. Both these systems will be replaced by the Navy Standard Integrated Personnel System (NSIPS) which will be replaced in turn by DIMHRS when it becomes operational. At the HQ level, the Navy Enlisted System and the Officer Personnel Information System (NES and OPINS) maintain information about regular Navy members, full-time support personnel, and any reservist recalled for 30 days or more. The Inactive Manpower and Personnel Management Information System (IMAPMIS) maintains information for Navy reserve and retired personnel. NES and OPINS are separate systems and gather data from several sources. The current data accuracy rate for field reporting is greater than 98.5 percent. (SRA, 1995)

[2] A discussion of the Reserve Standard Training Administration and Readiness Support (RSTARS) is beyond the scope of this report.

Although, the Navy can meet most of the information and reporting requirements, some changes are required to satisfy the requirement fully. These changes include the derivation of a Unit Identification Code (UIC) attached element and the addition of more data elements to measure military duty status.

Army: Many different field systems support the Army's components. RCAS supports tracking the reserve and National Guard personnel and SIDPERS-3 track active duty personnel. All Army components use Headquarters systems based on Total Army Personnel DataBase (TAPDB). More recently, the Inter-Component Data Transfer (ICDT), for the purposes of exchanging data between SIDPERS-3 and RCAS, has been created by the Army in response to some of the problems it encountered in keeping track of its members during Desert Shield and Desert Storm. The current data accuracy rate for SIDPERS-3 is 99 percent, and the accuracy for TAPDB ranges from 98-100 percent. (SRA, 1995)

The Army needs to modify the Military Duty Status and translate the value to DoD standards, increase the frequency of its reporting requirements, and modify its hardware and software to better accept, transmit, and translate its personnel tracking data.

Marine Corps: Marine Corps units use either the Unit Diary/Marine Integrated Personnel System (UD/MIPS) or the On-line Diary System (OLDS). UD/MIPS is a reporting and retrieval system for tactical personnel and pay data. All Operating Forces of the Active and Reserve components use UD/MIPS. Non-Fleet Marine Force units use OLDS, an on-line, transaction-driven system to input personnel and pay data within Marine Corps Total Force System (MCTFS). The MCTFS Central Master File sends relevant feedback messages and advisory notices to the units. One key to the efficiency of MCTFS is units take their UD/MIPS microcomputers with them when they deploy. The system does not operate any differently in a contingency situation than it does in garrison. The current Marine Corps reporting mission requires an accuracy of 100 percent. They measure data reporting timeliness with a goal of 96 percent or better. (SRA, 1995) The Marine Corps needs to translate its Military Duty Status and Physical Location data to DoD standards.

Air Force: During deployed operations, the Air Force uses the Base Level Manpower and Personnel (MANPER-B) module of the Contingency Operations/Mobility Planning and Execution System (COMPES) to support personnel operations. MANPER-B is a microcomputer-based system that provides base-level manpower and personnel support to deployed members of the Air Force Active and Reserve Components. MANPER-B provides data from the field to the Headquarters air Force (HAF) Personnel Data System (PDS). HAF-PDS and the field systems, Base Level Military Personnel System (BLMPS) and Personnel Concept III (PC-III), exchange information to complete peacetime reporting.

When the Air Force initially deploys an individual, it takes an extract of his or her file from BLMPS and puts it into MANPER-B. The advantage of the Air Force personnel systems is that they capture duty locations and record them for operational

purposes; field units have only the minimal burden of verifying the information. Current data accuracy for the Air Force strength reconciliation is 99.9 percent. (SRA, 1995)

The Air Force currently supports all of the military personnel tracking information and reporting requirements for deployed operations. However, while current technology is adequate to sustain the capability to record, store and transfer tracking information, the Air Force has indicated that they will require hardware and software upgrades to maintain the present level of capability. Current reporting procedures involve building a file from several data sources and passing the file to Defense Manpower Data Center (DMDC) with classified data. Interim procedures will involve the continuation of a file transfer, rather than the transaction format requested by DMDC. Air Force modernization efforts will allow for classified transactions that include TDY Attached Personnel Assignment System (PAS), GEOLOC, and country/state code. The only conversion required by the Air Force is that of changing their duty status into DoD standard format and values before transmitting to DMDC.

Noncombatant Evacuation Operations (NEO) Support System

The primary focus of the NEO is to provide data to support decisions designed to move non-combatants away from areas of crisis. Since more than one government agency is involved in the decision to evacuate NCs (made by the Department of State (DoS) with the assistance from DoD), coordination between the agencies becomes paramount to the success of evacuation missions.

There are five phases to the implementation of the NEO: Pre-operation, Assembly, Relocation, Evacuation, and Repatriation. The planning of the NEO mission is detailed in the preoperative phase. Planning includes the collection and the regular updating of data. It also includes the generation of State Department Report F77 that provides the estimates of the total number of eligible NCs in a designated area of operation, as well as the classification of NCs by employment category.

NCs are identified either from information garnered from DoD-affiliated personnel or personnel of other federal agencies. Other sources of information are the overseas command's ration control systems, the Defense Enrollment Eligibility Reporting System (DEERS), and DoS records. Data from these sources are combined and updated regularly to ensure a proper database of the core NC population. Thus, the NEO support system interfaces with all available data sources, classifies NCs by geographical area, and matches eligible NCs with responsible command personnel.

Joint Personnel Asset Visibility

As described above, the Services currently measure and track certain types of personnel data very differently. Joint Personnel Asset Visibility (JPAV) is a system that uses existing sources of personnel data from the Services to display personnel reports on everyone assigned to a JTF. It will eventually use common data elements generated by DIMHRS when it becomes operational. JPAV promotes functional consensus in areas such as language and other skill data, location, and civilian personnel tracking.

The JTF staff can use JPAV to track the status of all personnel assigned or attached to the JTF from the time of assignment or attachment, throughout their tour of duty, to the time of their separation from the JTF. JPAV will provide historical information to designated repositories upon the deactivation of the JTF. JPAV is part of the larger Joint Total Asset Visibility program which tracks deployed materiel as well as personnel. The JPAV system will promote cross-service communication and standardization of personnel data in support of the DIMHRS effort.

To facilitate identification of the necessary skills to satisfy the mission requirements of the JTF, JPAV can provide a "cross walk" between the military occupational codes of the four Armed Services, the Coast Guard, and civilian counterparts to military occupation codes. This data will be based on the Occupation Master Crosswalk File maintained by DMDC.

Also, achieving a general agreement among the Services on the use of Smart Card or GPS technology would enable JPAV users to gain access to data on the location of military and civilian personnel. Smart Cards could be scanned at various points (entry, departure, and dining facilities) to capture location of individuals through time.

JPAV technology essentially will give its users access to an integrated database containing information on units and individuals. The database will contain basic identifying information on individuals such as name, rank, social security number (SSN), and Service component for JTF personnel. Skills, qualifications, and other personnel resource data needed to support personnel tracking and readiness assessments will also be contained in the database. Primary sources such as Time Phased Force Deployment Data (TPFDD), Service personnel systems, transportation manifesting systems, and casualty reporting and tracking systems will provide data to update the integrated JPAV database on a frequent basis. The database will be accessible through a network using laptop or notebook computers serving as JPAV terminals. The computers will be connected through a CINC-supplied network to a database server containing the actual database.

The JPAV capability will provide support to users through all phases of the JTF's life cycle, from force planning through initial activation to operational employment and redeployment to historical reporting. Individuals will be tracked during their JTF tenure, either deploying as part of a unit or as an individual

When the JPAV is fully implemented, JTF staffs should realize an improvement over existing capabilities. Users will be able to access JPAV from an icon on the Total Asset Visibility (TAV) main menu. Screens, dialog boxes, menus and control buttons for JPAV will be consistent with the JTAV operating environment. JPAV will be compliant with the Defense Information Infrastructure (DII) Common Operating Environment (COE) Integration and Run Time Specification (I&RTS).

A carefully designed database that draws data from a range of primary sources will be the cornerstone of the JPAV capability. JPAV will reconcile and synchronize data from the primary sources and employ standard DoD data elements and data usage. The combined capabilities of pre-defined and ad hoc queries will give users the flexibility to answer questions ranging from routine to unusual. Data resulting from the query can be presented in summary or detailed format, as required by the user. While JPAV will not

initially be an analytical or decision support tool, its output could be incorporated into either type of tool.

The JPAV office recently completed a reengineering of the system to fix several problems with the database and to re-normalize the software to improve its performance. JPAV was scheduled to provide operational support in Bosnia beginning in February 1998. Atlantic Command (ACOM) planned to install JPAV at Norfolk in spring of 1998 for use in its JTF Simulation Center as a training ground for friendly and aggressor forces. Later, JPAV will provide operational support to Central Command (CENTCOM) and exercise support to Pacific Command (PACOM).

The JPAV and JTAV databases have been integrated and rigorous access control has been implemented. The system only operates at the Secret-High level although some extracts from the system are unclassified. DIMHRS is defining common data elements across the services and is a forum for working business rules issues that will eventually find their way into JPAV.

Real time personnel management for a CINC of a JTF can be improved with the implementation of a system such as JPAV. However, JPAV would only help to identify personnel requirements, personnel availability, and troop demographic characteristics. With the emergence and availability of new technologies, personnel location systems can be augmented to considerably improve the real time management of the JTF.

Section 3: Use of the Technology by the Armed Services - Medical Community

Medical Surveillance

The military medical community is also interested in location data and in taking advantage of related technologies. The Army tracks statistics to identify medical problems. In World War II (WWII) they tracked data on wounds to identify major causes. Having a history of location data on soldiers could help the military to identify problems such as the location and extent of mine fields or regions where a given disease is prevalent. In Vietnam, for example, unit affiliation was used to identify regions where malaria was a problem so that forces in those areas could take preventive measures. Having a history of location data on individual soldiers would facilitate gaining such insights earlier.

The Army Center for Health Promotion and Preventive Medicine (CHPPM) supports medical surveillance to identify the onset of medical problems. CHPPM has been gathering data on the location of personnel who were near Khamisiyah, Iraq when the chemical weapons stored there were destroyed near the end of Desert Storm. CHPPM has been part of a labor-intensive process of trying to reconstruct troop locations from paper records, interviews, and other sources. Having a record of the day-to-day location of individual deployed Service members would greatly simplify this process and improve the accuracy of the results.

CHPPM also supports the other side of medical surveillance, identifying the location of health hazards. CHPPM is using GPS technology to record the location of samples (air, soil, water) collected in Bosnia.

Personal Status Monitor

Another potential application of GPS technology is in the area of medical care. The Personal or Physiological Status Monitor (PSM) uses non-invasive sensors worn on the body and connected to communication and location systems to monitor physiological status.

The presence of a monitoring system, such as the PSM, will enhance trauma care on the "front lines" of the battlefield. PSM will revolutionize patient acquisition in the battle zone and improve combat casualty care by reducing battle-related deaths. The PSM determines vital signs and geo-location of individual soldiers before, during and after a battle. Data transmitted by the PSM to medical and command units will allow these units to monitor the readiness of their troops. When soldiers are injured or wounded, expert systems will rank the severity of the injury of multiple casualties, determine the distance and direction of those casualties, and transmit the prioritized data to medical units. This permits medics to rapidly respond to those casualties who require the most immediate attention. The ability to promptly respond would avoid the delay in initiating care beyond the "golden hour" during which treatment is most likely to prevent death or disability.

The availability of physiological data and protocols to guide initial evaluation will improve trauma care in the field. Moreover, ongoing monitoring and recording of physiologic data during evacuation will identify troops in need of critical care during transport. Finally, the ability to simulate and present physiologic data representing a variety of combat casualty conditions will help develop and maintain combat casualty management skills during peacetime. (Kind, 1997)

Portable Information Carrier

Another technology that has been developed is that of the Portable Information Carrier (PIC). PIC replaces the Field Medical Card which was a paper document used to record medical treatment of injured soldiers. The PIC technology is a Smart Card that at minimum contains personal information of Service members' shot records, training records, facility access data, and financial data. PIC technology captures vital information in a secure device that does not betray patient confidentiality. These data are usually accessed by PIC readers that can be placed in reception centers as well as on amphibious landing craft. The PIC may also be an appropriate vehicle for storing information on environmental exposures with geographic location to better assess when and where individuals might have been exposed to hazardous conditions.

PIC has been used to process troops in need of medical care when they return from deployments. Patient information is recorded in the PIC which can be accessed by users since that data is transmitted to consolidated databases to ensure that the information is not lost if the PIC were damaged or lost. A potential use of these consolidated databases is to support epidemiological studies to forewarn against hazards, as well as to perform retrospective analyses to determine relationships between illnesses and possible causative agents. There are also plans to upload data from the PIC to initialize an individual's PSM. There is some concern that if personnel data are stored on the PIC, the information could be used by captors to aid interrogation.

Patient Accounting and Reporting Real-time Tracking System

The military was embarrassed during Desert Shield and Desert Storm when it did not know the precise location of wounded soldiers who were being moved to medical treatment facilities in Europe or the United States. The Services are developing a tracking system called the Patient Accounting and Reporting Real-time Tracking System (PARRTS) to address this problem.

The customer Support Division (CSD) of the Corporate Executive Information Systems (CEIS) Directorate, the U.S. Army Medical Department Center & School developed PARRTS as a means to satisfy the need to identify the location, status, and condition of any patient in the total health care system.

PARRTS central is at Fort Sam Houston, Texas, and the CSD operates programs that support the database. This system continuously queries the Composite Health Care System (CHCS) in each fixed hospital and the Composite Health Care System-Deployable (CHCS-D) for patients that originate in contingency operations. It tracks the contingency patients, mass casualty (MASCAL) events, and selected other groups of patients that Army medical executives designate for special attention. The system is usually up to date within minutes or hours, depending on the frequency of reporting by the treatment facilities around the globe.

PARRTS also queries the U.S. Transportation Command's TRANSCOM Regulating and Command & Control Evacuation System (TRAC^{2}ES) for patients that are in the aeromedical evacuation system. Thus, a patient is visible from the time they enter a combat zone hospital until they are no longer a patient in the healthcare system.

There is a "desktop version" of PARRTS called PARRTS-D. Each day CSD condenses all of the data on selected patients and places it into a database file. Each Patient Administration Officer or senior medical executive downloads that file from electronic mail systems. PARRT-D allows them to look up facility workloads and to follow one specific patient through out the healthcare system, and several other actions.

Global Patient Movement Requirements Center

TRANSCOM also runs the Global Patient Movement Requirements Center (GPMRC) which receives reports on bed availability and which maps patients to available beds and schedules transportation. The Theater Patient Movement Requirements Center (TPMRC) recommends that GPMRC convert from peacetime regulating procedures to contingency medical regulating procedures when large numbers of patients are generated in relatively short period of time. The 128 medical specialties reported during peacetime drops to 13 broad medical/surgical specialties during a contingency. GPMRC notifies medical treatment facilities of the start of contingency procedures through their chain of command. Upon implementation, facilities submit an initial bed status report that outlines the number of operating beds and beds available by each of the 13 medical/surgical specialties. Any change in operating bed status is reported in its status reports. GPMRC controls beds at Military Treatment Facilities, Department of Veteran's Affairs facilities, and participating civilian hospitals.

Medical units in the theater report patients requiring evacuation to CONUS to their servicing TPMRC. The Air Evacuation Wing and theater TPMRC receive notice of the patient location and destination for movement. Air Force theater tactical aircraft and US Army ground/air evacuation (AE) units accomplish the movement of patients within a theater of operations. The movement policy considers the clinical status of the patient. Patients are moved from the hub at which the AE mission arrives to the nearest reception airfields that support the Military Treatment Facility designated by GPMRC. Patient reception and ground transportation from the airfield to the designated facility is the responsibility of the receiving hospital.

Section 4: Use of the Technology by the Armed Services - Field Commander

DoD has developed a master plan that provides an overarching strategy for integrating battalion and brigade-level staffs through digitized command, control, communication, and intelligence. This strategy, called C4I for the Warrior, provides guidance to the Services towards a common, global, C4I warfighting vision. Location data available through GPS-related technology is a major component of the C4I vision. Although no specific projects are being pursued to relay location data to the National Military Command Center (NMCC), the Pentagon renovation effort currently ongoing will provide additional communications and display capabilities that will facilitate displays in the Emergency Conference Room at the NMCC. The rest of this section provides an overview of Service initiatives that use location data to support the vision.

Force XXI

Force XXI is the first in a series of Army warfighting experiments designed to significantly enhance battlefield performance and communications. To improve battlefield performance, the Army is implementing digital systems that automate command, control and intelligence functions. Battlefield vehicles will be linked to the global positioning system using a wide range of digital technologies. Force XXI capitalizes on the digitization process to transform the Army into a more effective fighting force. The ability to assimilate information using information-related technologies is an integral aspect of the transformation process. The digitization of the battlespace, will enable CINCs to maintain a clear and accurate vision of the battlespace in order to support mission planning and execution by acquiring, exchanging, and using real time information that is tailored to their needs. Indeed, digital technology will allow CINCs to visualize the operation, formulate and analyze friendly and enemy courses of action, develop and communicate their intent, and monitor operations as is illustrated in Figure 1. Digital technology provides the CINC' with a horizontally and vertically integrated digital information network that supports unity of the battlefield fire and maneuver and assures command and control decision-cycle superiority. Within this framework, warfighters and commanders will have enhanced "situation awareness" and will be able to react to the dynamic nature of the non-linear battlespace.

Force XXI will provide situational awareness and command and control to the lowest tactical echelons from the Battle Command. It will facilitate a seamless flow of

battle command information across the battlespace, and will interface with external command and control and sensor systems (see Figure 1). The end result will be a vertical and horizontal integration of the digital battlespace and the brigade and below tactical unit levels. The GPS or an embedded position-navigation (POSNAV) capability will provide position navigation and reporting capability. Also, included is an interface to a terrestrial communication system (e.g., Single Channel Ground Air Radio System or Enhanced Position Location Reporting System (EPLRS) radio) or to a satellite communications system for operations over long distances or rugged terrain. Also, appropriate computer hardware, software, and interfaces will be installed on weapons platforms and vehicles at brigade-and-below echelons and deployed with individual dismounted soldiers.

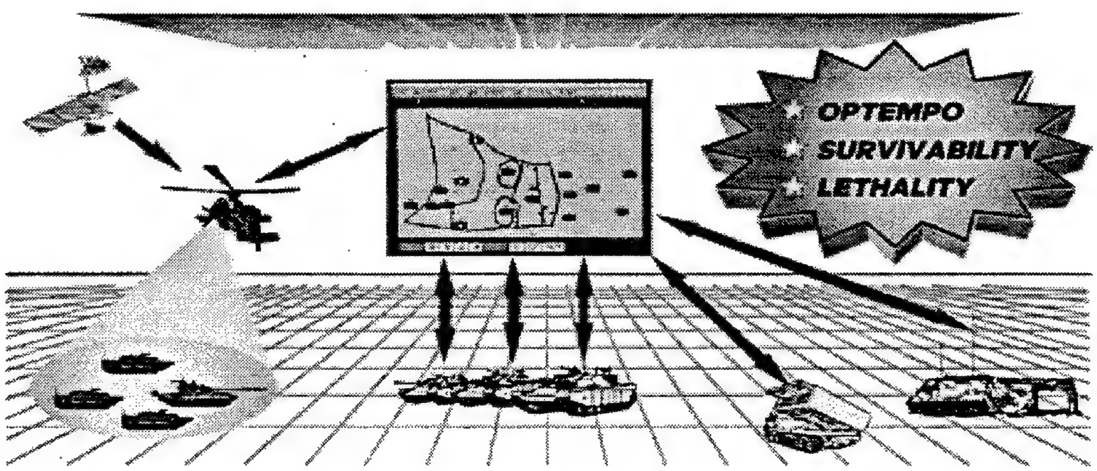

Figure 1:Shared Situational Awareness

The Army is developing a number of command and control systems to support digitized operations. These systems fall under an umbrella called the Army Battle Command System (ABCS) which includes the following systems:

- The Global Command and Control System – Army or (GCCS-A) operates at the strategic, theater, and echelons above corps levels.
- The Army Tactical Command and Control System (ATCCS) operates at the corps to battalion level.
- The Force XXI Battle Command Brigade and Below (FBCB2) operates, as its name implies, at brigade and below.

GCCS-A is the Army component of the Global Command and Control System (GCCS). Strategic, theater, and echelons above corps command and control has been provided by the World-Wide Military Command and Control System (WWMCCS) which is a mainframe system based on 1970's technology. WWMCCS is a "go to war" command and control system for force planning and deployment. During the 1980's DoD's large-scale effort to modernize WWMCCS failed. In 1992, DoD adopted an

evolutionary approach to replacing WWMCCS with GCCS. GCCS will use the Joint Operation Planning and Execution System (JOPES) to provide the same operational planning capability as WWMCCS. The JOPES data model provides standards for data elements in GCCS. The capabilities GCCS will provide include scheduling and tracking deployment activity and status through the Scheduling and Movement (S&M) system. The Logistics Sustainment Analysis and Feasibility Estimator (LOGSAFE) will help logistics planners determine sustained movement requirements during deliberate and crisis action planning. The Medical Planning and Execution System (MEPES) will provide contingency medical support information for allocating medical resources. The Non Unit Personnel Generator (NPG) will assist in determining the number of replacement and filler personnel needed. The Global Status of Resources and Training (GSORTS) system will provide information on the status of units with respect to personnel, equipment, and training.

There are several systems of interest within ATCCS. The Maneuver Control system (MCS) provides corps through battalion force level commanders and staffs the capability to graphically visualize the battlefield. It integrates information horizontally and vertically between echelons to provide a common picture of friendly and enemy unit locations. It provides the capability to develop and distribute battle plans and orders. It facilitates multi-node collaborative planning sessions through whiteboard and audio capabilities. MCS also supports resource management by displaying the current status of personnel, equipment and supplies.

The All Source Analysis System Remote Workstation (ASAS RWS) provides battle commanders with analyzed intelligence and unanalyzed combat information. The intelligence information it provides includes enemy situational awareness.

The Advanced Field Artillery Tactical Data System (AFATDS) provides command, control, and communication (C3) for Army and Marine corps cannon, rockets, missiles, mortars, close air support, and naval surface weapon systems. Among the capabilities it provides are digital situation awareness from Army, Marine, and Air Force ground and air-based sensors and from other C3 systems. It also provides horizontal and vertical coordination through the exchange of messages, maps, and graphics overlays.

The Air and Missiles Defense Workstation (AMDW/S) provides the commander with the ability to electronically generate and display weapon and sensor locations, manipulate map graphics, conduct terrain analysis, and analyze and monitor missions in near-real time. It provides the ability to display air control orders, current fire unit status, alert posture, missile expenditure, and personnel ready for air battle management duty.

The Combat Service Support Control System (CSSCS) provides battlefield division support and situation awareness for planning and controlling the logistics support of combat operations. CSSCS provides material and personnel status of units and identifies logistical capabilities to resupply units for subsequent combat operations. One of the capabilities it provides is to display resource status summaries of current logistics information by class of supply, item, or unit.

The Forward Area Air Defense Command and Control Intelligence (FAAD C2I) system provides Force XXI with air defense capabilities. It integrates the air defense fire units, sensors, and command and control centers into a coherent system capable of defeating or denying the low altitude aerial threat. The system provides rapid collection,

storage, processing, display and dissemination of critical, time-sensitive air and ground situational awareness and battle command information. It provides the third dimension situational awareness component for Force XXI by injecting near real time "air-tracks" of friendly, enemy, and unknown aircraft.

The Integrated Meteorological System (IMETS) provides high-resolution current and prognostic meteorological data and weather effects. It has the capability to provide weather overlays.

The Army Tactical Command and Control System (ATCCS) operates through radios over a wireless tactical internet. The client-server environment allows one system to view displays from another. Also, Netscape can be used to view the home page of other systems for information and displays. File Transfer protocol (FTP) can be used to send files between and among MCS and ASAS workstations. Several standard message formats are also available for sending information.

The third level system, Force XXI Battle Command Brigade and Below (FBCB2), is located on vehicles to provide seamless battle command capability to all leaders at brigade and below. It provides horizontal and vertical integration of the information generating and processing capabilities of individual weapons, sensors, and platforms. It provides real-time situation awareness of friendly unit locations. It displays reported enemy and unknown unit locations. FBCB2 displays "geo-reference" spot reports and calls for fire support. It can generate and display orders and overlays. It also provides logistics and personnel reports.

The 4th Infantry Division at Fort Hood is a test unit for many of the systems that are being developed to support the digitization effort. The Centralized Technical Support Facility (CTSF) is responsible for testing the interaction of the systems to ensure compatibility with other systems. The systems and tactics for using them have also been tested in Division-level Advanced Warfighting Experiments at the National Test Center at Fort Irwin.

Systems being tested at CTSF include the Maneuver Control System (MCS), Combat Service Support Command and Control System (CSSCS), Advanced Field Artillery Tactical Data System (AFATDS), Forward Area Air Defense Command and Control Intelligence (FAADC2I), and the All Source Analysis System (ASAS).

Land Warrior

The Land Warrior (LW) engineering, manufacturing and development program is a total system designed to improve the dismounted soldiers lethality and survivability. It is based on the proposition of enhancing troop capability through the integration of various components that include Command and Control, Lethality, Sustainment, Survivability, and Mobility. LW is the dismounted portion of the digitized battlefield architecture as defined by the evolving digitization policy, standards, and systems. The LW systems includes two radios which allow dismounted soldiers and units to fully participate in military operations where orders, intelligence, and other combat information are distributed in digital form. The Squad radio is a Single Channel Ground Air Radio System – System Improvement Plan (SINCGARS SIP) compatible radio. This radio has a maximum power of five watts and a range of approximately five kilometers.

Company and platoon communications will be performed using the Squad Radio. Further, there is a gateway function to connect to the ATCCS tactical internet described above. The soldier radio is a short-range (approximately 1.3 kilometers) radio that enables individual squad members to communicate via voice and data without taking hands off their weapon. The main purpose of the soldier radio is to replace hand signal and physical voice communications.

There are five elements in the Land Warrior system. These elements are the weapon subsystem, protective clothing and individual equipment subsystem, integrated helmet assembly (IHAS), Computer/Radio subsystem, and the Software subsystem. The weapons subsystem contains a digital camera that enables troops to carry out surveillance tasks and also to provide feedback to field headquarters. The computer/radio subsystem incorporates the GPS integrated navigation system, with a color hand-held flat panel display, and system voice control. This feature enables the troops to report back position movements, as well as receive location directions should they lose themselves in route, or find themselves astray from the mission. Soldiers can set the Land Warrior system to automatically report their location at certain time intervals. The integrated navigation system calculates a soldier's position from the last GPS data received which allows the soldier to continue navigation even if contact with the GPS system is lost.

In conjunction with the Land Warrior system, the Army has developed the Air Warrior (AW) and Mounted Warrior (MW) programs. Components of the AW are typically aircrew-mounted, with some potential for interface with aircraft-mounted equipment.

Other Service Initiatives Supporting the Digitized Battlefield

Copernicus is an effort that focuses on fielding systems that provide rapid access to essential data and allows for a top down dissemination of information. A goal of Copernicus is to create the conditions for a true sensor-to-shooter environment and to integrate C4I with the Combat Direction Systems (CDS). The Joint Maritime Command Information System (JMCIS) represents the first major step in fielding Copernicus.

Horizon is the Air Force vision for an information architectures that provides an integrated and responsive global system to support Air Force *Global Reach*, *Global Power* objectives. It also establishes an Air Force vision for 21st Century C4I infrastructure and enables the integration of information technology. Included in Horizon is the Communications Squadron 2000 initiative. This initiative redesigns the C4 force structure for deployed wings and base support infrastructure. Once, the C4 capabilities are deployed, combat wings would be able to plug into joint networks in the theater, accessing the system to provide commanders with real-time information on demand.

The Horizon vision can be achieved by complying with a standards-based information architecture, rapid assimilation of technology, common sense plans and policies, forward looking vision and sound resource management. Once achieved, Horizon would allow the warrior to exercise command and control through a user-transparent common operating environment of distributed, collaborative planning, and smart push-pull information facilities. Knowledge-based C4I systems will foster the

ability to push designated information to the user while simultaneously permitting the user to pull additional information from the digital environment as needed.

Other Systems Using Location Data

Soldier 911: Another application of GPS technology to support the Field Commander is the Soldier 911 System. Soldier 911 is a commercial Global Positioning Ultra High Frequency radio geo-location system which provides an audible alert when a soldier approaches a known border, includes distress alert capabilities, and provides an electronic soldier location report that can inform commanders of troop movements.

Soldier 911 has two separate systems, a ground-based and an air based. The ground-based system is used in both Macedonia and South Korea, while the air-based system is used only in South Korea. The ground-based system consists of hand-held GPS-112 units carried by troops and interrogator units which consists of a notebook computer and UHF radio. The Soldier 911 program modified the GPS-112 system by adding a "911" button, a border alert beeper, and a geo-location network report back system. As such, this system allows the user to program in waypoints for the border to prevent border trespasses by troops.

At the operational post (OP) level, the users can roll up the display of individual soldiers. A computer is housed at the base station that can display a map with the capability of tracking up to four soldiers using the time-division multiple access (TDMA) networking structure with various communication connectivity options. Position information can be relayed from the OP to command posts (CP) and to the battalion headquarters (BN). The ground-based system can accommodate "canned" text messages between hand-held, OP, CP and BN. This system can also allow the base to store location information for use at a later point in time.

The air-based system is similar in capabilities to the ground based system. It is used on the Blackhawk helicopters stationed in South Korea. This system is very large (replaces one seat in the helicopter) and weighs about 120 pounds. This system consists of a GPS unit, a 10-watt power amplifier, and a laptop with a moving map display. It displays TDMA maps that are updated every second, with helicopter positions updated every minute. In mountainous terrain, the helicopter can relay messages either free form or canned to the guardian control via landlines. The information can then be transmitted via landlines to CP and to the BN. The guardian control (base station) can handle 18 helicopters at a time. In addition to the Blackhawks, the Soldier 911 system has been installed in medical evacuation helicopters.

Survival Evasion Rescue and Escape (SERE): The Air Force and Navy are using the Hook-112 Survival radio system which includes voice radio, beacon, and location determining equipment. The radio is designed to initiate a quick rescue response from recovery forces in emergency situations. The radios come pre-programmed to improve flight and mission planning and allow users easy and fast send and receive capability. A downed pilot can use this system, which uses GPS technology, to plot his or her location to within a 100-meter radius. Aircraft equipped with interrogator equipment can receive line-of-sight signals from Hook-112 radios from 60 to 100 miles away.

Combat Survivor Evader Locator (CSEL): A Joint Service effort is underway to develop the Combat Survivor Evader Locator (CSEL) at a cost of about $5000 per unit. The CSEL is a search and rescue system with a range of up to 500 nautical miles. The system will allow two-way line-of-sight (LOS) voice communications between the evader and recovery forces as well as between evaders. The radio will be capable of geo-location using the GPS precise positioning service (PPS) under dual frequency operation. The CSEL will employ a Selective-Availability Anti-Spoofing Module (SAASM) to meet geo-positioning security requirements. The CSEL radio will be no larger than the existing Hook-112 radio. Up to 200 users can be on a network as long as they are in the same satellite footprint. The CSEL will be able to store up to 250 waypoints. The Air Force was scheduled to begin testing the system in December 1997.

Section 5: Potential Future Uses of the Technology

Air Force Personnel Community

This section discusses potential future uses of emerging individual location tracking technology by the Air Force personnel community. Subsequent sections discuss future uses by the Air Force medical community and field commanders. Potential uses of the technology at the tactical unit level are discussed in the field commander's section.

The Air Force personnel community consists of: the Deputy Chief of Staff for Personnel (HQ USAF/DP) and his or her staff and support agencies; the Air Force Personnel Center; Air Education and Training Command; Air Force Recruiting Service; the personnel staffs at Major Command (MAJCOM) headquarters; and the manpower, personnel, and training research functions within the Air Force Research Laboratory (AFRL). Collectively this community is responsible for recruiting, selecting, classifying, training, sustaining, and distributing the right numbers and kinds of officers and airmen needed to carry out missions assigned to the Air Component Commanders of the Unified Combat Commands.

To fulfill this responsibility, the Air Force personnel community needs two types of data on individual officers and airmen; real-time data for day-to-day personnel management and historical data for trend analysis, planning, and research. Location is a critical element of both types of data. The Air Force identifies the location of individuals by coding their unit of assignment and duty location in the personnel data system. Unit and base-level personnel technicians make changes to these data elements by processing update transactions through the personnel data system. Individual duty histories are maintained in the personnel data system. Because location changes are processed manually, there are opportunities for errors and delays between the time an individual changes location and recognition of that change in the data system, even under peace time conditions. Rapid deployments, especially to remote areas, increase the opportunity for delays and errors. This is one area in which the Air Force personnel community could benefit from new location tracking technologies.

The Air Force is currently involved in an effort to upgrade the Manpower and Personnel Module (MANPER) of the Contingency Operations/Mobility Planning and

Execution System (COMPES) to support the Deliberate/Crisis Action Planning and Execution System. The revised system relies on an extract from the Personnel Data System (PDS) to initially populate the personnel database for a deployed unit. Data updates for the deployed personnel can be generated within the unit and passed back to the PDS or passed to the deployed unit from PDS. A review of the revised system and the data elements incorporated in the subset of the PDS revealed little that could be updated via an automated location tracking system.

Unlike the Army and Marine Corps (but similar to the Navy), only about 5 percent of Air Force personnel (i.e., the aircrews) are potentially mobile over the battlefield. The remaining 95 percent are support personnel who maintain, repair, refuel, and rearm aircraft from fixed locations, even during deployments to remote areas. Therefore, the need to track precise geographic locations of individuals is much less in the Air Force (and Navy) than it is in the Army and Marine Corps. Aircrews are already tracked with considerable precision using GPS, AWACCS, and internal flight data recorders. For the rest of the Air Force, knowing an individual's unit of assignment (and the location of that unit) at any given point in time pretty well pinpoints the individual's geographic location.

Probably the most productive use of emerging location tracking technology for the Air Force personnel community would be the application of Smart Cards for updating locations. If each officer and airman had a smart ID card that could be passed through a reader each time he or she changed unit of assignment or location (PCS or TDY), the updating of location data in the personnel data system could be greatly improved in terms of both accuracy and timeliness. Of course, the data links between the card readers and the personnel data system would also have to be automated and improved to fully exploit the advantages offered by the cards. Procedures to periodically refresh location data (e.g., once a week at the dining hall, at Commanders Call, or during formations) would substantially improve the accuracy of the data, but would require expansion of the fields for storing the information in the personnel data system.

This use of Smart Cards was validated by the Wing-IDEF Project, a Functional Process Improvement/Business Process Reengineering effort for Air Force Objective Wing activities. This project looked extensively at various Automated Identification Technology (AIT) systems and strategies and concluded that the only technology currently applicable to the personnel community is the Smart Card. Smart Card readers would be placed in a variety of locations and depend on the communications systems to forward the data to the centralized personnel data systems.

Another possible use for new location tracking technology might be in analyzing Air Force job and organization structures. If precise individual locations could be tracked over time via GPS and displayed graphically during training exercises, Air Force personnel researchers and planners would gain insight into more efficient ways to allocate tasks to jobs, jobs to specialties, and specialties to work teams. Instrumenting the flight lines at a few large operational training centers (e.g., Nellis AFB), and collecting data on a variety of units as they rotate through for training, could generate the data fairly inexpensively and unobtrusively.

If the Army is successful in digitizing the battle field and extending command and control technology down to the individual soldier, the Air Force personnel community

should be able to take advantage of the research and development to satisfy its much more modest personnel location tracking needs at relatively low cost.

Air Force Medical Community

The Air Force medical community includes hospitals and clinics established at deployed locations including those in both fixed and portable facilities, aeromedical evacuation units, and military treatment facilities that receive casualties.

PARRTS, TRAC^{2}ES, and GPMRC will improve the tracking of patients during movement. Tracking could be improved further if GPS unit were placed on litters used to transport certain categories of patients, such as intensive care patients.

GPS systems can also help medical logistics to track critical items, particularly those with a limited shelf life such as blood. Standard CVAN containers already allow for some tracking, provide an electronic inventory of contents, and provide an audible response when queried for location within a warehouse. Specific items with limited shelf life such as blood could carry individual GPS trackers to ensure that they are used before its expiration date.

Using Smart cards to record a history of an airman's location during a deployment would help identify individuals who might have been exposed to health hazards that are identified after the fact. Data stored on Smart cards could be read upon departure from the deployed location and archived to provide a record.

Air Force Commanders

Air Force and Joint Service systems and development efforts already take advantage of new location generating technology to track aircraft and downed flight crews during operations. Air Force liaison personnel assigned to forward Army units will benefit from the Army's digitized battlefield effort. Through these systems, commanders can track the small percentage of Air Force personnel who do not remain at a fixed base during a deployment.

Systems such as JPAV will help commanders know the status of the forces assigned to them and anticipate shortages. Providing regular updates to location data using Smart cards readers would improve the quality of the data available to the commanders. Expanding the skill data available in such systems will enhance the ability of the commander to match the right person to the right job.

List of Abbreviations

Abbreviations	Definition
ABCS	Army Battle Command System
ACE	Air Combat Element
ACOM	Atlantic Command
AFATDS	Advanced Field Artillery Tactical Data System0
AMDW/S	Air and Missiles Defense Workstation
ARPA	Advanced Research Projects Agency
ASAS-RWS	All Source Analysis System Remote Workstation
ATCCS	Army Tactical Command and Control System
AW	Air Warrior
BLMPS	Base Level Military Personnel System
BN	Battalion headquarters
C3	Command, Control and Communications
CA code	Coarse Acquisition code
CDS	Combat Direction System
CE	Command Element
CENTCOM	Central Command
CEIS	Corporate Executive Information System
CHCS	Composite Health Care System
CHCS-D	Deployable Composite Health Care System
CHPPM	Army Center for Health Promotion and Preventive Medicine
CINC	Commander-in-Chief
COE	Common Operating Environment
COMPES	Contingency Operations/Mobility Planning and Execution System
CONUS	Continental United States
CP	Command Post
CSD	Customer Support Division
CSEL	Combat Survivor Evader Locator
CSSCS	Combat Service Support Control System
CTSF	Centralized Technical Support Facility
CVAN	Container Van
DEERS	Defense Enrollment Eligibility Reporting
DGPS	Differential Global Positioning System
DII	Defense Information Infrastructure
DIMHRS	Defense Integrated Military Human Resource System
DLI	Defense Language Institute
DMDC	Defense Manpower Data Center
DMRS	Diary Management Reporting System
DoD	Department of Defense
DS/DS	Desert Storm / Desert Shield
DSSU	Dismounted Soldier System Unit
DVA	Department of Veterans Affairs
EPLRS	Enhanced Position Location Reporting System
FAAD C2I	Forward Area Air Defense Command and Control Intelligence
FBCB2	Force XXI Battle Command Brigade and Below
FCC	Federal Coordinating Center

Abbreviation	Description
FMF	Fleet Marine Force
FTP	File Transfer Protocol
GCCS-A	Global Command and Control System
GCE	Ground Combat Element
GEOLOC	Geographic location
GPS	Global Positioning System
GPMRC	Global Patient Movement Requirements
GSORTS	Global Status of Resources and Training
HAF	Headquarters Service
I&RTS	Integration and Run Time Specification
ICDT	Inter-Component Data Transfer
IHAS	Integrated Helmet Assembly
IMAPMIS	Inactive Manpower and Personnel Management Information System
IMETS	Integrated Meteorological System
J-1 staff	Joint Staff supporting the Director of Manpower and Personnel
JMCIS	Joint Maritime Command Information System
JOA	Joint Operations Area
JOPES	Joint Operation Planning and Execution System
JPAV/JTAV	Joint Personnel Asset Visibility/Joint Total Asset Visibility
JTF	Joint Task Force
JTF-CINC	Joint Task Force-Commander-in-Chief
LOGSAFE	The Logistics Sustainment Analysis and Feasibility Estimator
LOS	Line of Sight
LW	Land Warrior
MANPER-B	Base Level Manpower and Personnel
MASCAL	Mass Casualty
MEDCOM	Medical Command
MCM	Multi-Chip Module
MCS	Maneuver Control System
MCTFS	Marine Corps Total Force System
MEPES	Medical Planning and Execution System
MOS	Military Occupation Specialty
MPM-21	Military Personnel Management for the 21st Century
NEO	Non Combatant Evacuation Operations Support System
NES/OPION	Navy Enlisted System/Officer Personnel Information system
NSIPS	Navy Standard Integrated Personnel System
NPG	Non Unit Personnel Generator
OLDS	On-line Diary System
OP	Operational Post
OSD	Office of the Secretary of Defense
P code	Precision broadcast code

Abbreviation	Description
PACOM	Pacific Command
PARRTS	Patient Accounting & Reporting Real time Tracking System
PARRTS-D	Desktop version of Patient Accounting & Reporting Real time Tracking System
PAS	Personnel Assignment system
PASBA	Patient Administration System & Bio statistics Activity
PC-III	Personnel Concept III
PDS	Personnel Data System
PIC	Personal Information Carrier
POSNAV	Position-Navigation
PPS	Precise Positioning System
PSM	Personal Status Monitor
RCAS	Reserve Component Automation System
S&M	Scheduling & Movement
SAASM	Selective-Availability Anti-Spoofing Module
SADL	Situation Awareness Digital Link
SDS	Source Data System
SERE	Survival Evasion Rescue and Escape
SIDPERS-3	Standard Installation/Division Personnel System-3
SINCGARS SIP	Single Channel Ground Air Radio System – System Improvement Plan
SSN	Social Security Number
TACP	Tactical Air Control Party
TAPDB	Total Army Personnel Data Base
TDMA	Time-Division multiple access
TDY	Tour of Duty
TPFDD	Time Phased Force Deployment Data
TPMRC	Theater Patient Movement Requirements
TRACES	TRANSCOM Regulating Command & Control Evacuation System
TRANSCOM	Transportation Command
UAV	Unmanned Aerial Vehicles
UHF	Ultra High Frequency
UD/MIPS	Unit Diary/Marine Integrated Personnel System
UIC	Unit Identification Code
VHF	Very High Frequency
WWMCCS	World-Wide Military Command and Control System

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